PadhAI: The Convolution Operation

One Fourth Labs

Examples of 2D convolution

How is the convolution operation used in practice?

1. Let us consider a 3x3 kernel and run it over an image, pixel-by-pixel.
2. This is done to re-estimate every pixel in that 3x3 neighborhood

Input 30 x 30	conv	Kernel 3x3	Output 30x30 (blur)
	*	1/9 1/9 1/9 1/9 1/9 1/9 1/9 1/9 1/9	

   a. Here, we can see that the kernel is essentially an average operation, so what it does is it converts the value of every pixel to $\frac{1}{9}^{th}$ of its original value.

   b. In any photo editing tool like GIMP or Photoshop, when we select an image blur, we are essentially performing a convolution operation using an average valued kernel.

3. Let's look at another convolution operation

Input 30 x 30	conv	Kernel 3x3	Output 30x30 (sharpens)
	*	0 -1 0 -1 5 -1 0 -1 0	

   a. Here, the selected pixel is magnified by multiplying by 5 and then we subtract the 4 neighbors from it. This results in a sharper image, as it boosts the current pixel, thereby making it appear more prominent when compared to its neighbors.

4. Let's look at one more example

Input 30 x 30	conv	Kernel 3x3	Output 30x30 (Edge detection)
	*	1 1 1 1 -8 1 1 1 1	

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a. Here, pixels near others pixels of the same value are reduced to 0, leaving only the edges.